UNITED STATES PATENT OFFICE.

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COMPOUND EXPLOSIVE-ENGINE.

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To all whom it may concern:

Be it known that I, JOSEPH A. WILLIAMS, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Compound Explosive-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

My invention relates to compound explosive engines of the four-cycle type, and has particular reference to means for scavenging the high-pressure cylinders by means of air which is drawn through said cylinders by suction produced by the advance movement of the piston in the low pressure cylinder. Various details of construction by which the above stated operation is effected are also employed, which details will be hereinafter set forth in the specification, and particularly pointed out in the claims.

In the accompanying drawings forming part of this application:—Figure 1 is a view partly in section and partly in elevation of a compound explosive engine provided with my invention, one of the high pressure cylinders and the low pressure cylinder being shown in section; Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1 and looking toward the left; and Fig. 3 is a similar view taken on the line 2—2 and looking toward the right.

In compound explosive engines, the quantity of the explosive mixture employed, and also the richness thereof, varies with the condition of service. When a large quantity of normal mixture is used in the ordinary engine of this type, the exhaust from the low-pressure cylinder is at a comparatively high pressure, which represents a considerable waste and loss in efficiency. Or, if the engine be so designed that the exhaust under the conditions stated is at a low pressure, then, when a smaller quantity of mixture, or a more dilute mixture, is employed, the final exhaust will be below atmospheric pressure; and a consequent loss of efficiency results due to a back pressure upon the low pressure piston. Also, the ordinary compound explosive engine is non-scavenging, a portion of the burned gases remaining in the cylinder after the completion of the exhaust stroke of the engine; and, when the quantity of mixture used is small, these burned gases dilute the explosive mixture and, in extreme cases, may so weaken it as to prevent explosion altogether.

In the engine shown in this application I have provided means for scavenging the high-pressure cylinders and for relieving or supplying the vacuum which the low-pressure cylinder tends to create, by placing upon the high-pressure cylinders inlet air valves, which admit air to these cylinders whenever the pressure therein falls materially below the atmosphere. In case a comparatively small amount of the explosive mixture or dilute mixture is employed, the pressure during the exhaust from the high pressure cylinders will quickly be reduced below the atmosphere, and, consequently, a large amount of air must be supplied. As the low-pressure piston will move very rapidly, it will not be possible in all cases for the necessary air to enter through the air valves on the high pressure cylinders; and, to prevent back pressure under these conditions, I also provide an auxiliary air valve in the low pressure piston.

Referring now to the drawings, in which similar reference characters designate corresponding parts throughout the several views, 1 represents the base plate of the engine, upon which are mounted at its opposite ends the frame pieces 2, and near the center, the pillow blocks 3. Journaled in said frames and pillow blocks is the main or crank shaft 4, upon one end of which is the ordinary fly-wheel 5.

Suitably supported upon the end frames are the cylinders of the engine, the high-pressure cylinders being represented at 6 and 7, and the low-pressure cylinder at 8, said low pressure cylinder being situated between the high-pressure cylinders. The high-pressure cylinders are provided with pistons 9, but one of these pistons being shown, said pistons being connected by rods 10 to cranks 11 on the shaft 4. Within the low-pressure cylinder is a piston 12, which is connected by a piston rod 13 with cranks 14, also upon the main shaft 4. The cranks 11 for the high-pressure cylinders extend from the main shaft in the same direction, while the cranks 14 extend in the opposite direction therefrom, or at an angle of 180 degrees from the cranks 11.

The explosive mixture is admitted to the high-pressure cylinders through the pipes 15, leading from a suitable carbureter, not